ENHANCED VIEWING EXPERIENCE OF A DISPLAY THROUGH LOCALISED DYNAMIC CONTROL OF BACKGROUND LIGHTING LEVEL

TECHNICAL FIELD

[0001] This invention describes a method to enhance the viewing experience of a flat panel display of any video or still imagery through the localized dynamic control of the background lighting level of a specific area or areas of a scene or succession of video frames. This can be accomplished using a unique arrangement of two stacked flat panel displays, one of which would control backlight brightness values synchronized to appropriate areas within the scenes or images of the visual content being presented on the other display. This control could be provided over the video signal cable (DDC), serial, USB or a customized type of interface protocol.

BACKGROUND ART

[0002] Multi-layered display (MLD) units provide a significant improvement over existing single layer display (SLD) units or displays. MLD units may be used to nest display content over spacially displaced or stacked layers to provide an enhanced mechanism for information absorption and analysis by users. An example of an existing multi-layer display is discussed for example in WO9942889A.

[0003] Reference throughout this specification will also be made to the present invention being used in conjunction with multi-layer displays of the type disclosed in WO9942889A. However, those skilled in the art should appreciate that the present invention may also be adapted for use with other types of MLD units and reference to the above only throughout this specification should in no way be seen as limiting.

[0004] The frequency spectrum of radiation incident upon a detector depends on the properties of the light source, the transmission medium and possibly the properties of the reflecting medium. If one considers the eye as a detector the human visual system can sense radiation that has a wavelength between 700 nm and 380 nm. Hence this is described as the visual part of the electromagnetic spectrum. Humans perceive certain frequency distributions as having different colours and brightness. A scheme was devised to describe any perceived colour and brightness via adding three basis spectral distributions with various weights. For example in the 1931 CIE colour space any perceivable colour may be described by the following equation:

$$C=x_rX+y_rY+z_rZ$$

Where C is the colour being described, Xr, Yr and Zr are the weights and X, Y and Z are 1931 CIE tristimulis curves which are graphs of the relative sensitivity of the eye Vs wavelength. For any given colour, the weights may be determined by the following equations:

$$x_r=\int C(\lambda)X(\lambda)d(\lambda)$$

$$y_r=\int C(\lambda)Y(\lambda)d(\lambda)$$

$$z_r=\int C(\lambda)Z(\lambda)d(\lambda)$$

[0005] The 1931 co-ordinates are formed via the following normalisation:

$$x_r = \frac{X_r}{X_r + Y_r + Z_r}$$

$$y_r = \frac{Y_r}{X_r + Y_r + Z_r}$$

$$z_r = 1 - x_r - y_r$$

These may be plotted on the 1931 CIE diagram. The spectral locus defines the pure spectral colours, that is the perception of radiation with a specific wavelength. Colour co-ordinates that are closer or farther from pure spectral colours are described as being more or less saturated respectively. The value of the y coordinate is also referred to as the luminance or the variable L.

[0006] Pixels on a transmissive display, that is a display that channels light from a rear mounted source, will be capable of maximum and minimum luminous states. If one labels the maximum state as Lb and the minimum as Ld then the contrast ratio is described by

$$C_r = \frac{L_b}{L_d}$$

[0007] The perception model described above accurately predicts that colours on displays can be formed by mixing small areas of three basis colours with modulated intensities which are close in either spatial or temporal proximity. If the basis colours are plotted on the CIE diagram then the enclosed triangle contains all the colours producible by the system. The enclosed area is called the colour gamut and hence a display with a larger area can display a greater variation in colour and has a greater colour gamut.

[0008] There are two main types of Liquid Crystal Displays used in computer monitors, passive matrix and active matrix. Passive-matrix Liquid Crystal Displays use a simple grid addressing system to supply the charge to a particular pixel on the display. Creating the grid starts with two glass layers called substrates. One substrate is given columns and the other is given rows made from a transparent conductive material. This is usually indium tin oxide. The rows or columns are connected to integrated circuits that control when a charge is sent down a particular column or row. The liquid crystal material is sandwiched between the two glass substrates, and a polarizing film is added to the outer side of each substrate.

[0009] A pixel is defined as the smallest resolvable area of an image, either on a screen or stored in memory. Each pixel in a monochrome image has its own brightness, from 0 for black to the maximum value (e.g. 255 for an eight-bit pixel) for white. In a colour image, each pixel has its own brightness and colour, usually represented as a triple of red, green and blue intensities. To turn on a pixel, the integrated circuit sends a charge down the correct column of one substrate and a ground activated on the correct row of the other. The row and column intersect at the designated pixel and that delivers the voltage to untwist the liquid crystals at that pixel.